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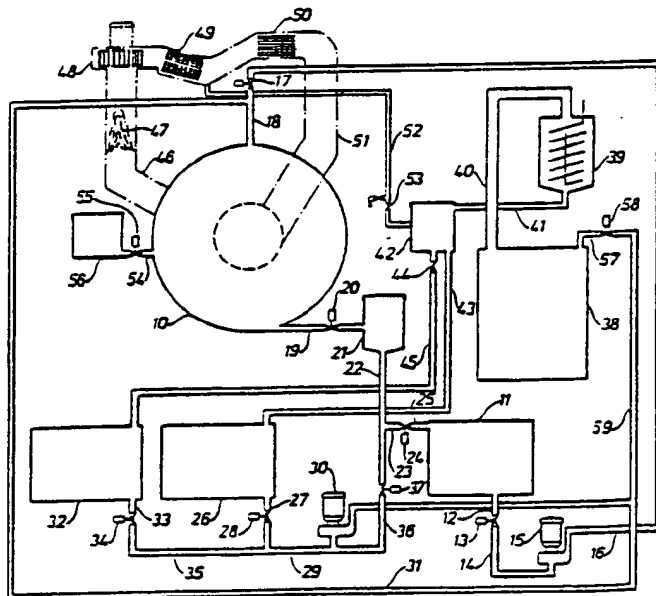
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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**(54) Title:** A METHOD OF WASHING TEXTILE OBJECTS AND A DEVICE FOR PERFORMING THE METHOD

**(57) Abstract**

A method of washing textile objects comprises pre-washing in a liquid composed of an organic dissolvent, preferably perchloroethylene, main washing in a liquid composed of a mixture of the organic dissolvent, a tenside and water, and at least two subsequent rinsing period, the objects being spin dried after each washing or rinsing period. The main-washing liquid is composed of a microemulsion whose water contents amount to between 4 and 30, preferably 10 - 30, percentage by weight and the first rinsing is made in a liquid composed of the organic dissolvent to which tenside has been added. A device for performing the method comprises three receptacles (11, 26, 32) for storing microemulsion, perchloroethylene, and used rinsing liquid from the first and preferably also from the second rinsing, respectively. The three receptacles communicate with a container (10) for the objects to be washed, which container can be supplied with tenside and water, respectively, from a dosing device (56).



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A method of washing textile objects and a device for performing the method

This invention relates to a method of washing textile objects comprising a washing period during which the objects are treated in a washing liquid composed of an organic dissolvent, preferably perchloroethylene, water and tenside, the liquid forming a microemulsion.

5 Traditionally, textile clothes can be cleaned either by washing in water or by dry cleaning. Water cleaning is active in normally soiled clothes (pigment dirt) whereas dry cleaning is effective for clothes soiled by oil, grease and the like. Some clothes which are very dirty and soiled by oil, for example garage workers overalls, often need both washing in water and dry cleaning to become satis-  
10 factorily clean.

To be forced to use both washing in water and dry cleaning for cleaning working clothes is a procedure which is both time-consuming and expensive. Furthermore, washing in water requires a treatment temperature during the washing period which amounts to 60 °C or more. This involves a high energy  
15 consumption. Therefore it has been investigated whether it is possible in some way to combine the two washing methodes so as to make the washing process more effective and shorten it. These investigations have led to active detergents composed of mixtures of a tenside, which is normally used for washing in water, an organic dissolvent of the type used for dry cleaning, and water. If for instance  
20 perchloroethylene is chosen as organic dissolvent, by suitable composition of the said components mixtures are obtained in which the water acts as a microemulsion in perchloroethylene. Characteristic of such a microemulsion is that it is thermodynamically stable, i.e. it is stable without stirring, within a pre-determined temperature range, usually from room temperature up to abt. 30 °C. The  
25 microemulsion is also characterized by comparatively high water contents, up to 20 - 30 percentage by weight. The tenside of the emulsion is in principle an emulgator consisting of non-ionic surface active compounds to which if desired small quantities of anionic compounds have been added. The tenside also includes a solubility agent which increases the effectivity of the washing liquid on dirt  
30 which is soluble in water. Examples of suitable tensides will be given below.

The microemulsions have proved to have a very good cleaning effect on heavily soiled working clothes, both for dissolving pigment dirt and for removing impurities based on mineral oils. Furthermore, the washing process can be



performed at room temperature and thus there is no need for heating the washing liquid. Hence, the process will be more energy-saving than if common washing in water had to be included.

The invention, which is based on the findings related above, has for its  
5 object to provide a method of washing by which textile clothes, for example heavily soiled working clothes, can be freed of pigment dirt and oils in a single process at low temperature, preferably within the range of 20 - 30 °C. Micro-emulsion is a comparatively expensive detergent and therefore it is desired to be able to re-utilize it in several successive washings. Another object of the  
10 invention is to make such repeated use possible. A further object is to provide a device for performing the said method of washing.

The related objects are achieved by a method comprising the measures defined in the following Claims 1 - 9 and in a device having the characteristic features defined in Claims 10 and 11.

15 A description of the invention will now be given and in that connection technical aspects relating to the method will be discussed and a device be described with reference to the accompanying drawing the single Figure of which shows the schematic construction of a washing machine for microemulsion cleaning.

20 As pointed out above, by washing in microemulsion very good cleaning results are obtained which otherwise at best could be reached only by both dry cleaning and cleaning in water. However, when it comes to utilizing the microemulsion washing in practice several problems arise which the invention means to solve. One such problem is the fact that the microemulsion due to its  
25 re-utilization is gradually impoverished of tenside and water. These components of the emulsion therefore must be re-dosed at appropriate times. For instance it may be necessary to add tenside before each new washing process. Another problem is that the microemulsion will successively be mingled with pigment dirt and particles of dye and this increases the risk of greying in the case of several  
30 repeated uses. A solution to this problem is to filter the microemulsion, for example through filter paper, after each washing process.

To prevent that the microemulsion is unnecessarily loaded with impurities based on mineral oils a pre-washing in perchloroethylene is proposed. To enhance the cleaning effect on water-based dirt also tenside can be added as well as small  
35 quantities of water. In the following main-washing water and tenside will be bound in the clothes. Thus the microemulsion will be short of these components. The said dosing of tenside and water to the pre-washing liquid counteracts this impoverishment. The pre-washing must be followed by spin drying of the clothes so that

most of the impurities are separated together with the pre-washing liquid. The latter can in known manner be purified from the impurities by distillation.

After washing in microemulsion the clothes have to be rinsed at least once and preferably twice. The microemulsion washing as well as the rinsings must be  
 5 followed by spin drying cycles, which are extremely important for the final washing result. The rinsings are preferably made in pure perchloroethylene. However, after washing in microemulsion the clothes will contain microemulsion residues which in the event that rinsing is made in pure perchloroethylene can be precipitated in viscous form which is extremely difficult to remove. To avoid this,  
 10 tenside is added to the rinsing liquid in the first rinsing after the microemulsion washing. The quantity of tenside can preferably be 0,5 percentage by weight. The second rinsing, however, can be made in pure perchloroethylene because then the microemulsion residues are so small that the risk of precipitation thereof is insignificant.

15 From a rational point of view it is advantageous if the rinsing liquid of the first rinsing, which is mainly perchloroethylene, can be used as pre-washing liquid in connection with the pre-washing of a subsequent washing process. The contents of microemulsion after the first rinsing is estimated to be abt. 4%. To avoid dissolution, i.e. precipitations in viscous form, of the microemulsion, tenside of  
 20 abt. 0,5% has been added already during the rinsing process, as said above. This liquid can be used as pre-washing liquid without any further addition of tenside.

Tests have been made in a launderometer with sample pieces of cotton and polyester/cotton, respectively, with and without finish, which have been soiled  
 25 washing in microemulsion and two rinsings. Cleaning and greying were measured by reflexion L in a Hunterlab spectrophotometer. The cleaning is stated as a percentage determined in accordance with the following:

$$\text{Cleaning in \%} = \frac{L_{\text{washed}} - L_{\text{soiled}}}{L_{\text{clean}} - L_{\text{soiled}}} \cdot 1000$$

Greying is stated as a reduction of the reflexion L, i.e.

30  $\Delta L = L_{\text{washed}} - L_{\text{not washed}}$

The launderometer washings were made at 25 °C.

The pre-washing went on for 5 min. followed by washing in microemulsion for 30 min. after which two rinsings, each during 5 min., and drying between filter papers in room temperature accomplished the washing process .

35 The washing results appear in the following table in which are also inserted comparative values from washings made in a corresponding way with the sample



pieces only treated in perchloroethylene. The table comprises results from washings in which two different microemulsions and three tensides have been used.

Example	1	2	3			
5 Tenside		Tenside 1	Tenside 2			
Pre-washing	Perchloroethylene	Per. + 4% microem. 1 +0,5% Tenside 1	Per. + 4% microem. 2			
Main washing	"	Microemulsion 1	Microemulsion 2			
Rinsing 1	"	Per. + 0,5% Tenside 1	Per. + 6% Tenside 3			
10 Rinsing 2	"	Perchloroethylene	Perchloroethylene			
	Cleaning %	Greying $\Delta L$	Cleaning %	Greying $\Delta L$	Cleaning %	Greying $\Delta L$
Cotton soot/oil	10,8	8,4	17,3	0,3	31,6	0,2
D/B without fio*	19,0	6,8	39,7	0,3	51,0	0
15 D/B with fio*	25,5	5,1	36,1	0,9	46,4	0

\* fio = finish soot/oil

Bath ratio 1:50

Load 100 g of glass balls

The composition of the tensides is as follows:

20		Tenside 1	Tenside 2
		%	%
	Perchloroethylene	95	95
	Ca-dodecylbensensulphonate	1,5	-
	Na-laurylsulphate	-	0,03
25	Nonylphenol + 8 EO	0,5	4,97
	Nonylphenol + 20 EO	1,5	-
	n-butanol	1,5	-

EO in the table represents ethylene oxide.

Tenside 3 and Tenside 2 are related such that Tenside 3 + 0,5% natrium-dodecylsulphate equals Tenside 2.

The composition of the two microemulsions are as follows:

	<u>Microemulsion 1</u>				<u>Microemulsion 2</u>		
	Perchloroethylene	79	weight %		Perchloroethylene	70	weight %
	Water	15	"		Water	15	"
35	Tenside 1	6	"		Tenside 2	15	"

From the results it appears that with respect to cleaning as well as to greying both of the microemulsion alternatives are better than treatment in pure perchloroethylene. Particularly the problems of greying become much less in microemulsion washing.

Also tests on an industrial scale have been made with microemulsion washing in accordance with the following programme

	<u>Period</u>	<u>Description</u>	<u>Time in min.</u>
	1	Pre-washing (per. + 0,5% tenside)	8
5	2	Spin drying	4
	3	Micro emulsion washing	10
	4	Spin drying	4
	5	Rinsing (per. + 0,5% tenside)	6
	6	Spin drying	2
10	7	Rinsing (pure per.)	4
	8	Spin drying	4
	9	Drying and venting, emptying	abt. 24
	Total		66

Both the launderometer tests and the industrial tests have shown that the microemulsion washing is very effective as concerns removal of pigment and oil as well as sweat.

The construction of a washing machine for performing the washing method in accordance with the invention will be outlined with reference to the Figure. The machine comprises a washing drum, not shown, which is rotatably mounted in a container 10. The drum is connected to a motor, not shown, which drives the drum on one hand with a washing speed of rotation and on the other hand with an increased spin drying speed of rotation. Connected to the container 10 are several receptacles, in which are kept the washing and rinsing liquids to be used. Thus, a receptacle 11 for microemulsion is connected to the washing drum via a conduit 12, a valve 13, a conduit 14, a pump 15, a conduit 16, a valve 17 and a conduit 18. The container 11 is further connected to the outlet 19 via a valve 20, a needle trap 21, a conduit 22, a conduit 23, a valve 24 and a conduit 25. A receptacle 26 for perchloroethylene is connected to the container 10 via a conduit 27, a valve 28, a conduit 29, a pump 30, a conduit 31 and the conduit 18. Another receptacle 32 for perchloroethylene is connected to the conduit 29 and thus also to the container 10 via a conduit 33, a valve 34 and a conduit 35. Further, the receptacle 26 is connected to the outlet 19 of the container 10 via a conduit 36 connected to the conduit 26 and a valve 37 connected to the conduit 22.



For recuperation of the perchloroethylene contained in impurified rinsing liquids a distiller 38 is provided and a cooler 39 therefor, to which it is connected via a conduit 40. The cooler 39 is connected via a conduit 41 to a water separator 42 which via a conduit 43 is connected to the receptacle 26 and via a valve 44 and a conduit 45 is connected to the receptacle 32. By the connection to the distiller system the receptacle 26 is continuously supplied with pure perchloroethylene whereas the receptacle 32 can be refilled via the valve 44 when necessary.

For drying and ventilation of the laundry the container 10 is connected to a dryer system comprising a conduit 46 including a nap filter 47, a fan 48, a cooler 49, a heater 50 and a conduit 51. The perchloroethylene recuperated in the dryer system can via a conduit 52 with a valve 53 be conveyed to the water separator 42 and thence to the receptacles 26 and 32. Finally, the container 10 is via a conduit 54 and a valve 55 connected to a dosing device 56 for tenside and water, respectively. Further, the distiller 38 is connected to the conduit 31 via a conduit 57, a valve 58 and a conduit 59.

The function of the washing machine will be described below with reference to the above programme for washing in microemulsion tested on an industrial scale. According to this programme there is at first a pre-washing in perchloroethylene. The container 10 is thus connected to the receptacle 26 from which liquid is supplied. It is assumed that this washing process succeeds several washing processes of similar type. The liquid in the receptacle 26 has thus been utilized as rinsing liquid in the first rinsing after the microemulsion washing and hence it contains microemulsion residues and tenside. As already said, pure perchloroethylene is continuously supplied to the receptacle 26 from the distiller system. Therefore it is necessary also to portion from the dosing device 56 to the pre-washing liquid in the first place tenside and possibly also water. When pre-washing has been accomplished the pre-washing liquid is pumped by the pump 30 via the outlet 19, valve 20, needle trap 21, conduit 22, valve 37, conduit 36, conduit 31, conduit 59, valve 58 and conduit 57 to the distiller 38. After spin drying microemulsion is supplied from the receptacle 11, and the main washing starts. When the washing period is accomplished the microemulsion is conveyed back to the receptacle 11, and this reconveyance continues also during the spin drying period. In the subsequent first rinsing the laundry will contain residues of microemulsion and thus the rinsing liquid supplied from the receptacle 26 may need an additional supply of tenside so that there will be no precipitation of the microemulsion residues. The rinsing liquid supplied from the receptacle 26 contains partly microemulsion, and partly tenside and water. Dependent on the quantities of the



components concerned it may be necessary to supply additional tenside and possibly also water. After the rinsing period the rinsing liquid is conveyed back to the receptacle 26.

5 The second rinsing is made in pure perchloroethylene supplied from the receptacle 32. At this stage the residues of microemulsion in the laundry are so small that it is not necessary to add tenside in order to avoid high-viscous precipitations. After rinsing the rinsing liquid is conveyed to the receptacle 26 to be used as rinsing liquid in subsequent first rinsings. After spin drying the drying system is operated and the vapours of perchloroethylene thus generated are  
10 cooled in the cooler 49 and the condensate is conveyed via the conduit 52, water separator 42 and conduit 43 to the receptacle 26.

The microemulsion will successively be mingled with dirt and dye particles as well as with impurities based on oil. Since the microemulsion is used unchanged washing after washing it has therefore to be exchanged after a number of  
15 washings. For this purpose the receptacle 11 can have a drain tap, not shown, as well as a filling device.

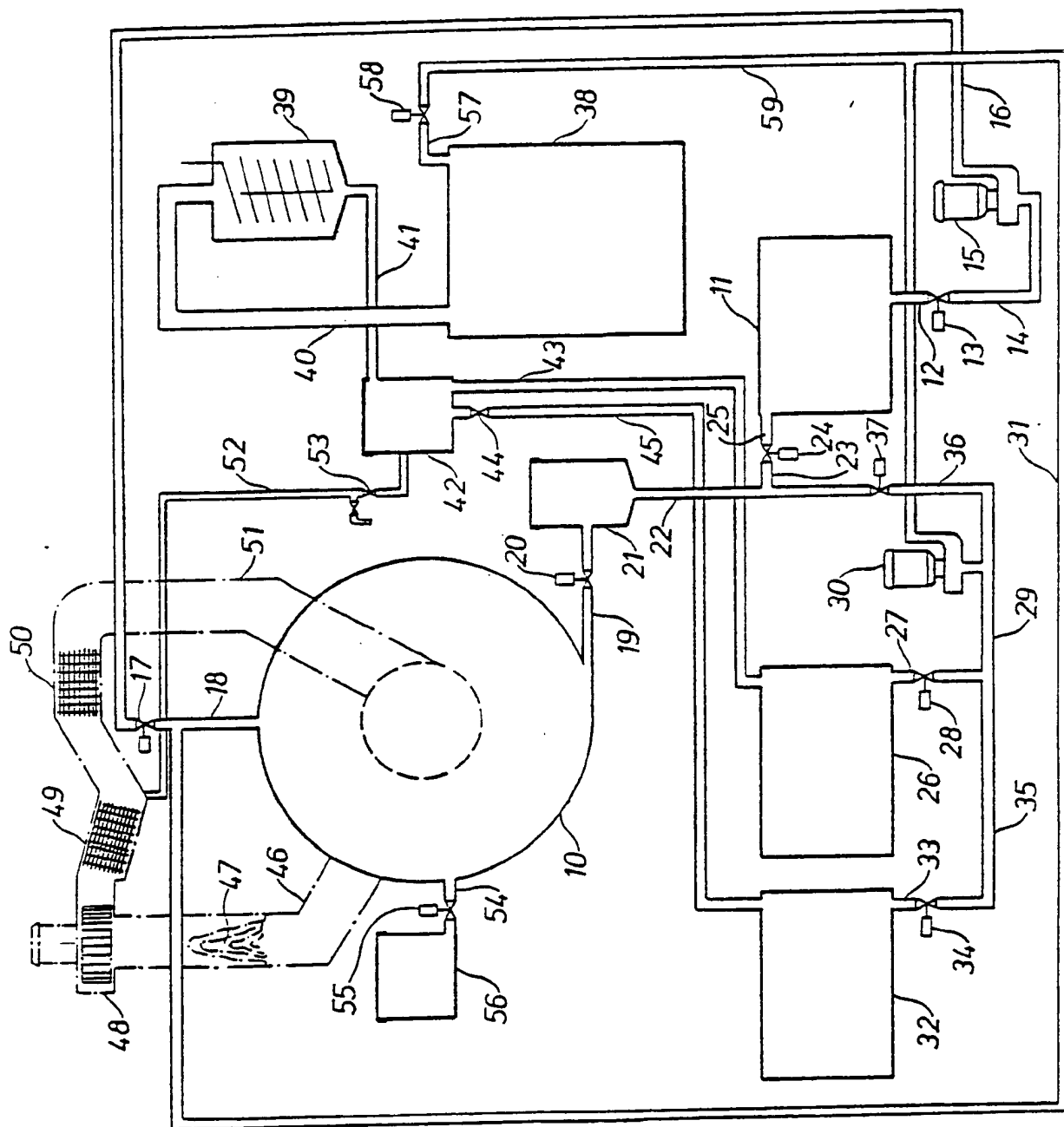
The receptacle 26 is supplied on one hand with pure perchloroethylene from the distiller 38 and on the other hand with substantially pure perchloroethylene taken from the receptacle 32 and used as rinsing liquid in the second rinsing.  
20 Further, liquid is taken from the receptacle 26 and is used as rinsing liquid for the first rinsing whereafter it is returned to the receptacle. Finally, liquid is taken from the receptacle 26 to be used as pre-washing liquid. The latter liquid, however, is after the pre-washing transferred to the distiller. It would appear from the above that it may be difficult to estimate beforehand the composition of  
25 the liquid in the receptacle 26 after several washing periods. One way of solving this problem is to analyze at suitable intervals the liquid with respect to the contents of tenside and water so that incurred losses can be compensated via the dosing device 56 and thus the risk of high-viscous precipitations be eliminated. If the demand for accuracy is not too high automatic analyzing equipment can be  
30 used. This function as well as the function of pumps, valves and the like included in the machine can be controlled by the programme device, not shown.

## Claims

1. A method of washing textile objects comprising a pre-washing period during which the textiles are treated in a liquid composed of an organic dissolvent, preferably perchloroethylene, a main washing period during which the objects are treated in a liquid comprising a mixture of the organic dissolvent, a tenside and  
5 water, and at least two subsequent rinsing periods, the objects being spin dried after each washing or rinsing period, characterized in that the main-washing liquid is composed of a microemulsion with water contents of between 4 and 30, preferably 10 - 30, percentage by weight, and that the first rinsing is made in a liquid composed of the organic dissolvent to which a tenside  
10 has been added.
2. A method according to Claim 1, characterized in that a tenside has been added to the pre-washing liquid.
3. A method according to Claim 2, characterized in that the contents of tenside of the pre-washing liquid amount to 0,2 - 3 percentage by weight.
- 15 4. A method according to Claim 2 or Claim 3, characterized in that a small quantity of water is added to the pre-washing liquid.
5. A method according to Claim 4, characterized in that the contents of tenside and water, respectively, are ensured by adding of an appropriate quantity of the microemulsion used for the main washing.
- 20 6. A method according to any preceding claim, characterized in that the first rinsing is made in a liquid whose contents of tenside are 0,2 - 3, preferably 0,4 - 0,8, percentage by weight.
7. A method according to any preceding claim, characterized in that the liquid of the first rinsing is separated to be used as pre-washing liquid in the  
25 next following washing process.
8. A method according to any preceding claim, characterized in that the microemulsion is filtered before being re-used.
9. A method according to Claim 8, characterized in that the microemulsion is filtered through a filter paper.
- 30 10. A device for performing the method according to any preceding claim, including a treatment drum disposed in a container (10) for the objects to be washed and distiller means (38) connected to the container (10) in order to receive used washing liquid, characterized by a first receptacle (11) for microemulsion, a second receptacle (32) for pure perchloroethylene, a third receptacle  
35 (26) for the rinsing liquid used for the first rinsing and a dosing device (56) for portioning of tenside and water, respectively, into the container (10), the three receptacles (11,26,32) being connected to the container (10) in order to supply to

the latter pre-determined quantities of liquid stored in the relevant receptacle, the first (11) and the third (26) receptacle being connected to the container (10) to receive therefrom used microemulsion and rinsing liquid, respectively.

11. . A device according to Claim 10, c h a r a c t e r i z e d in that the third  
5 receptacle (26) is connected to the container (10) so as to be supplied therefrom with liquid used in the second rinsing.



# INTERNATIONAL SEARCH REPORT

International Application No PCT/SE81/00388

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (If several classification symbols apply, indicate all) *		
According to International Patent Classification (IPC) or to both National Classification and IPC 3		
D 06 L 1/04, D 06 F 43/00		
<b>II. FIELDS SEARCHED</b>		
Minimum Documentation Searched *		
Classification System	Classification Symbols	
IPC 3	D 06 L 1/00-1/10, D 06 F 43/00-43/08	
US C1	8:142; 68:13; 68:18	
National C1	8a:5/01	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched *		
SE, NO, DK, FI classes as above		
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT</b> 14		
Category *	Citation of Document, 14 with indication, where appropriate, of the relevant passages 17	Relevant to Claim No. 14
X	US, A, 3 689 211 (J J GIAMPALMI JR, ET AL) 5 September 1972	1-11
A	DE, A, 2 333 676 (BROWN & GREEN LTD) 24 January 1974 & GB, A, 1 451 600	1, 2, 7
A	US, A, 3 583 181 (BRILLET A L M) 8 June 1971	10-11
<p>* Special categories of cited documents: 14</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"Δ" document member of the same patent family</p>		
<b>IV. CERTIFICATION</b>		
Date of the Actual Completion of the International Search *	Date of Mailing of this International Search Report *	
1982-04-05	1982-04-15	
International Searching Authority *	Signature of Authorized Officer 18	
Swedish Patent Office	<i>Lina Hylén</i>	

